

Hidden Pathogens in Root and Jawbone

Online Learning Video Activity Script

International Academy of Oral Medicine and Toxicology (IAOMT); www.iaomt.org

Last updated November 2020

PREFACE TO IAOMT’S HIDDEN PATHOGENS IN ROOT AND JAWBONE ONLINE LEARNING VIDEO ACTIVITY

Text on screen:

Welcome to IAOMT’s Hidden Pathogens in Root and Jawbone Online Learning Video Activity. The “Materials” tab above this video, as well as the text box below this video, contain links to references and resources cited in this activity, scientific literature related to the topics presented, and a script for this entire video. The successful completion of a quiz at the end of this activity is required for individuals participating in an IAOMT course.

In offering this activity, the IAOMT’s intention is to present as much scientific information as possible on different dental materials, treatments, patient and dental staff safety, and other aspects of dentistry.

The objective of the Hidden Pathogens in Root and Jawbone Online Learning Video is that at the conclusion of this activity, participants will be familiar with the systemic impact of root canal therapy and tooth extraction, as well as the implications of facial pain syndromes and jawbone pathologies.

The IAOMT emphasizes that health care practitioners must make their own professional judgments for the benefit of themselves and their patients and staffs. You are responsible for exercising your own judgment concerning the specific treatment options to utilize in your practice; for complying with applicable laws and regulations including local dental practice acts and informed consent requirements; and for abiding by insurance requirements including written declarations of coverage.

Only proceed if you understand and agree with these statements.

If you are ready to proceed, the activity will begin with me, Griffin Cole, DDS, NMD, MIAOMT, Steve Koral, DMD, MIAOMT, and Stuart Nunnally, DDS, NMD, FIAOMT, providing you with the coursework for this Hidden Pathogens in Root and Jawbone Online Learning Video Activity.

INTRODUCTION

Welcome to the International Academy of Oral Medicine and Toxicology, the IAOMT, training course on Hidden Pathogens in Root and Jawbone. In this training course, we will get into some of the less well-known and more controversial topics in contemporary dentistry.

We'll look into:

-How tooth extraction can lead to permanent injury of the jawbone, even when the superficial tissue appears perfectly well-healed.

and

-Why some dentists think that root canal treatments are inherently unhealthy, and why some even reject it entirely as a valid procedure.

Despite the fact that these topics have received virtually no attention from mainstream dentistry, they have been the subject of concern in the conversations of biological dentistry for many decades, calling into question some of the most routine procedures.

We begin the story of hidden pathogens with an examination of bone pathology. We look at the unique nature of the jaw bones and their interface with the outside world through the teeth. We also discuss the toxic nature of root canal treatments and see how root treated teeth don't always heal the way we expect.

A BONE DISEASE

There is a disease of bone called ischemic osteonecrosis. It is really a disease process. It can affect any bone, though it's most often seen in the hip, knee, and facial bones.

Orthopedists think about it all the time. This is because it is a precursor to several morbid states of the weight bearing joints, such as hip fractures and degenerative osteoarthritis of the knee.

Anyone familiar with contemporary dentistry will know that dentists hardly think about it at all. It rarely effects the overall functioning of the jaws. Even though research has shown that it underlies most cases of neuralgic pain, it's rarely recognized as such. Many dental authorities don't even recognize that it exists in the jaw bones at all.

Ischemic osteonecrosis is a process that involves impaired outflow of blood from the marrow space, increased intramedullary blood pressure, and reduced blood flow circulations in the bone marrow. This results in the death of osteocytes and other marrow tissues.

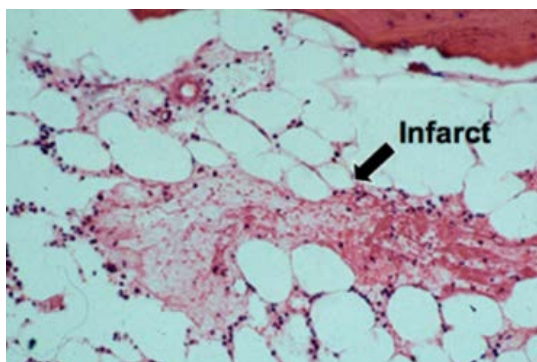


Photo courtesy of Dr. Jerry Bouquot; former website at www.maxillofacialcenter.com

Microscopically, it is characterized by dilated capillaries with micro clots and infarcts. There are areas of empty lacunae in calcified tissue and loss of integrity of that trabecular structure.

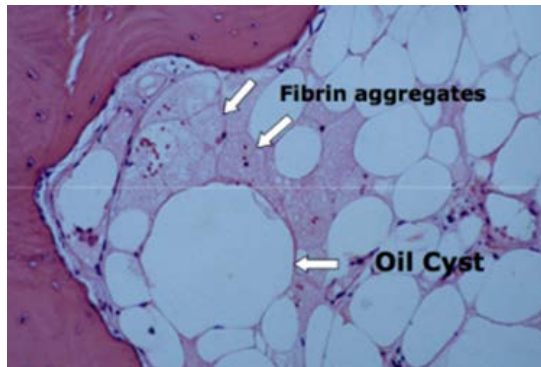


Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

There are dead fat cells replaced by loose fibrosis, and oil cysts, or globules, of free lipids. Surprisingly, inflammatory infiltrates are not a factor.

Infection and trauma are known to be the primary factors that predispose bone marrow to this condition, leading a long list of other influences.

Chronic ischemic bone disease is literally “bone death.” It is a process that creates diseased or dead bone marrow resulting from a diminished (abrupt or chronic) blood flow. It can affect any bone; usually from poor outflow from the bone, and usually causes increased marrow pressures and pain, but may be painless. Hips, knees, and jaws are most often affected.

Subsets of this disease include bone marrow edema (mild form), regional ischemic osteoporosis (mild form), avascular necrosis (severe form), etc.

Characteristics:

- Like inflammation, not so much a disease in its own right as it is a generic process
- A local reaction to a variety of systemic and or local factors which reduce nutrition and blood flow to marrow
- Unpredictable onset
- May become self-perpetuating
- Characteristically multifocal 50-80%
- Characteristically bilateral; mostly hips, knees, jaws
- Very difficult to see on radiographs

The original source of this information was the former website of the Maxillofacial Center for Education & Diagnostics at www.maxillofacialcenter.com.

There are dozens of trigger events for this bone disease, with several being...

- Infection and trauma
- Estrogen therapy or pregnancy
- Corticosteroid therapy
- Autoimmune disease (lupus = increased coagulation)
- Malnutrition (starvation, anorexia)
- Anemia
- Alcoholism
- Frequent hyperbaric changes
- Radiation and chemotherapy
- Metastatic cancer
- Bisphosphonates
- Hypothyroidism

The original source of this information was the former website of the Maxillofacial Center for Education & Diagnostics at www.maxillofacialcenter.com.

The basic problem is that marrow is especially susceptible to clots and infarcts. Blood flows sluggishly through marrow and flows out slowly. Normal intermedullary pressure is high. Ischemic disease is the only bone disease in which outflow is even further drastically reduced (80% of cases). Intramedullary pressures in osteonecrosis can be five times greater than normal because of back up pressure. Stagnation occurs, increasing risk of clots. Inherited excess clotting tendencies compound this problem, increasing susceptibility to infarction. Clotting disorders affect 20% of the population. About four out of five Chronic Ischemic Bone Disease (CIBD) cases have hyper-coagulations status.

Neuralgia-Inducing Cavitational Osteonecrosis (NICO) is a jawbone version of ischemic osteonecrosis. By definition, NICO is associated with pain. Osteonecrosis itself may or may not be painful. It may or may not affect multiple sites in one bone, or multiple bones.

The disease may or may not produce pain and the intensity of symptoms is not related to the amount of bone destroyed. Recent dental literature has seldom discussed asymptomatic ischemic osteonecrosis of the jaws, but the older literature, including the classic oral pathology textbook by G.V. Black, contains many examples of painless intramedullary “dry rot” or cavitation, usually under terms such as “bone caries” and “chronic osteitis” to distinguish it from osteomyelitis.

In 1915, G.V. Black first described these lesions in jawbones as follows:

“An osteomyelitis-like bone disease which seemed not to be a true infection, but rather a slow, progressive, unexplained death of cancellous bone and marrow, cell by cell.”

Attributed to *Black GV. A Work on Special Dental Pathology. Chicago: Medico-Dental Publ Co, 1915.* by Shankland W E. Differential Diagnosis of NICO Lesions. TMJ & Facial Pain Center. Columbus, OH.

Avascular bone associated with residual or unhealed extraction sockets, with or without pain, was also reported long ago and has recently been cited as a “red flag” or warning sign for medullary ischemia severe enough to prevent proper healing after surgery.

THE JAWS ARE UNIQUE

We tend to think that blood circulation in the head and face is more than adequate. But it can be a different story inside the bone marrow. Several features make the jawbones unique among the bones of the body and uniquely susceptible to developing issues with ischemic osteonecrosis.

No other bone has structures like the teeth that penetrate to the outside world. All the infections and trauma that teeth are subject to, mean that the jawbones end up suffering more infection and trauma than all the other bones combined. Usually those infections are chronic, leading to prolonged stress upon the blood circulation in marrow spaces.

And, of course, many of the procedures we routinely performed on teeth subject the underlying bone to high stress. For example, root canal treatments for teeth with periapical infections frequently don't heal completely, even when they feel fine and look fine on an x-ray. They leave some degree of scarring, inflammation, and even bacterial biofilms on the apical surface.

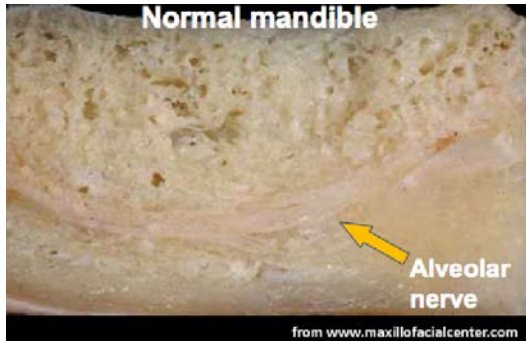
Extraction of teeth is also far from a benign process. We extract the tooth and leave the bony socket exposed to the elements in an open wound, a process that would be unthinkable in any orthopedic surgical procedure. Remnants of periodontal ligament left on the walls of the socket can prevent the bone from completely remodeling and filling in the way it is expected to do.

Routine use of vasoconstrictors is another problem. Anesthetics with epinephrine can reduce blood flow in the jaw bones by as much as 70 percent. In a long procedure where anesthesia is maintained for an hour or more, the lack of blood flow becomes a significant stress on the vitality of bone cells.

Dr. Jerry Bouquot, a professor emeritus of Oral Pathology at the University of Texas, Houston, has done the most to systematize our knowledge of ischemic jawbone pathology. Dr. Bouquot's research on jawbone pathology is extensive, and much of the information, and many of the photos in this video activity have been provided to the IAOMT courtesy of Dr. Bouquot. Listen to this short clip from IAOMT's podcast *Word of Mouth* to hear more about why jawbone pathology is unique in this interview conducted by IAOMT's Stuart Nunnally with Dr. Bouquot.

Insert 4:10-6:55 of <https://wordofmouth.iaomt.org/s01-e05-jerry-bouquot-dds-msd-neuralgia-inducing-cavitation-osteonecrosis-nico/>

OVERVIEW OF ISCHEMIC OSTEONECROSIS IN THE JAWS



In a section of normal mandible, as shown in this autopsy specimen, the cancellous bone has an intact trabecular structure, light yellow and hard, with an intact cortex surrounding the alveolar nerve.

Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

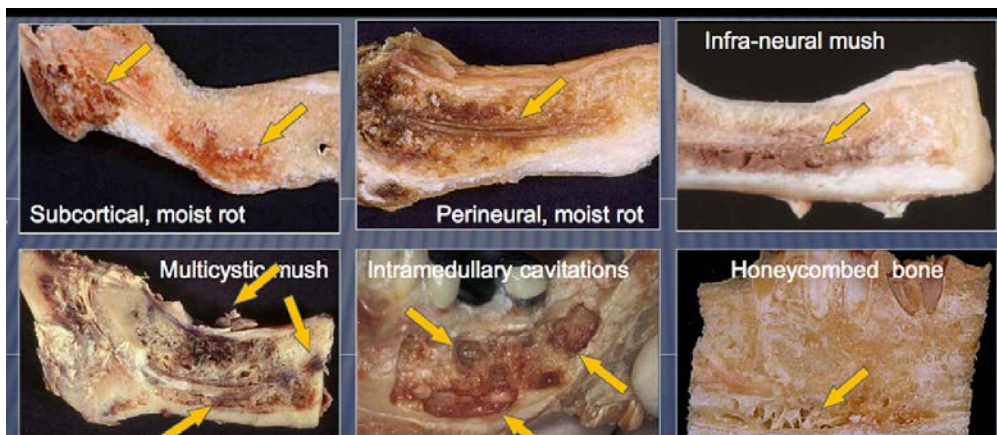


Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Mandibular bone marrow affected by ischemic osteonecrosis turns brown, soft and mushy, and will form hollow zones, often quite large, referred to as "cavitations."

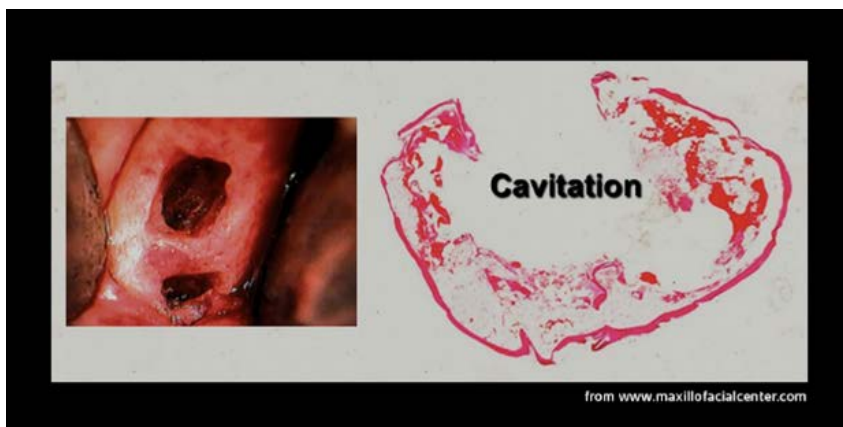


Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Often the periosteal cortex is gone, and the nerve is found to have degenerated as well. In this autopsy series, 51% of the edentulous sites had evidence of ischemic osteonecrosis.

DETECTING ISCHEMIC OSTEONECROSIS IN THE JAWS

Detecting lesions of ischemic osteonecrosis in the jaw bones of living people has been difficult without specialized techniques. The appearance of these lesions on normal two-dimensional periapical or panoramic radiographs is often indistinct.

However, once we get used to the idea that the jaw bones are particularly likely to be affected and our eyes become alerted to looking for ischemic lesions on normal x-rays, we can begin to see the lesions everywhere.

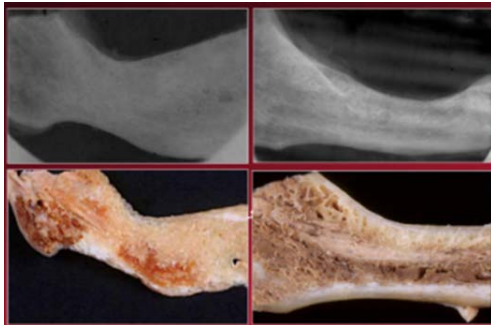
The vast majority of these very common lesions are not painful. But the very fact that we know the bone is not normal leaves us with questions, such as

Should we consider them pathological?

Should they be subjected to some minor form of therapy?

Can they have significant impact on a person's general health?

Specialized Imaging Techniques



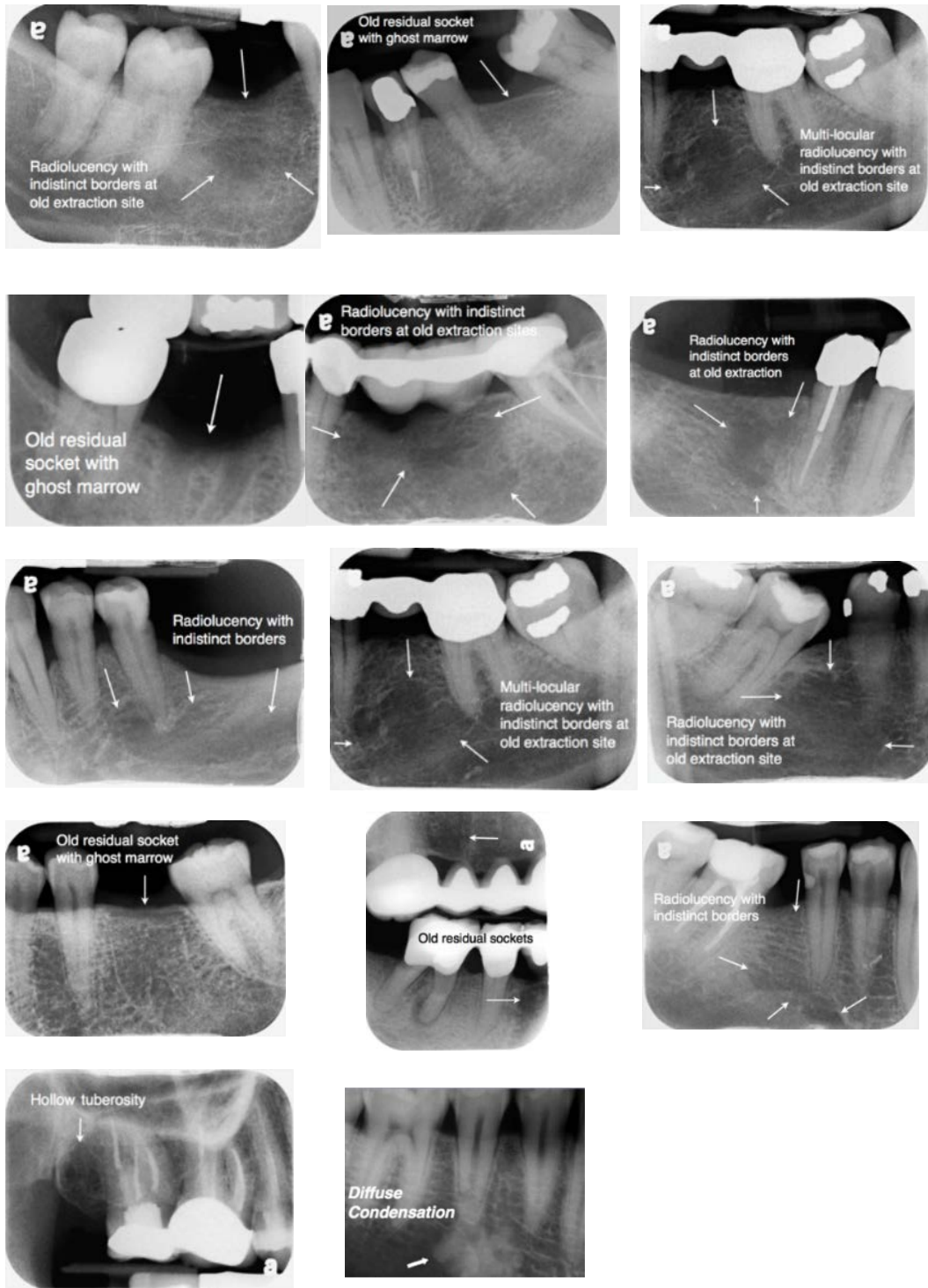
The appearance of ischemic osteonecrosis lesions in the jaw bones on normal two-dimensional periapical or panoramic radiographs is often indistinct. These lesions can easily be ignored as variants of normal when we're not on the alert to look for them.

You can see in these two dramatic examples from the autopsy series that the radiographs may not show any evidence of the osteonecrosis that actually exists inside the bone.

Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

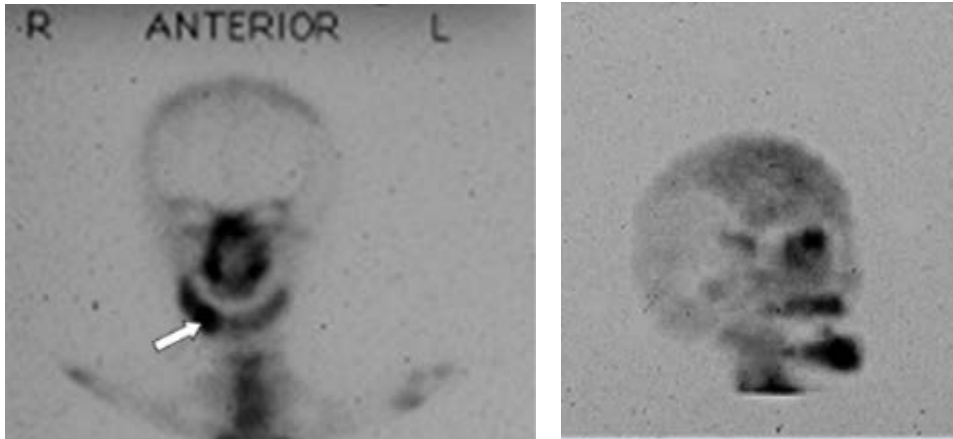
Ischemia on 2D Radiographs

Radiographic features that were considered variants of normal, or merely unexplainable, can be recognized as being of ischemic origin when we get used to the idea. Normally, an extraction site should completely remodel and heal in 6-12 months. The following images suggest that the sites are affected by ischemia to a degree that the full healing is impaired.



Photos courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

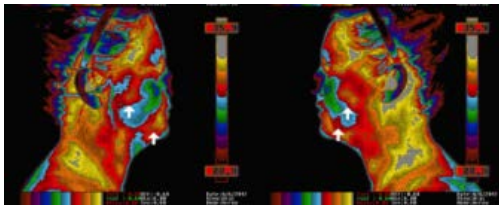
Bone Scans



Photos courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Technecium-99, or SPECT bone scans are used to find areas of the skeleton where bone is either being formed or destroyed more actively. The osteonecrotic region, where mineralized crystals are more exposed, attracts the 99mTc-bisphosphonate tracer more avidly than surrounding normal bone. Some amount of blood perfusion is necessary. Occasionally there will be an image where the affected area is wider than normal, indicating no circulation at all.

Thermography



Thermographic imagery can be used to give evidence of a general region that is under stress, inflammation, or infection. There seems to be a phenomenon of increased circulation around an area that may be affected by diseased bone.

Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

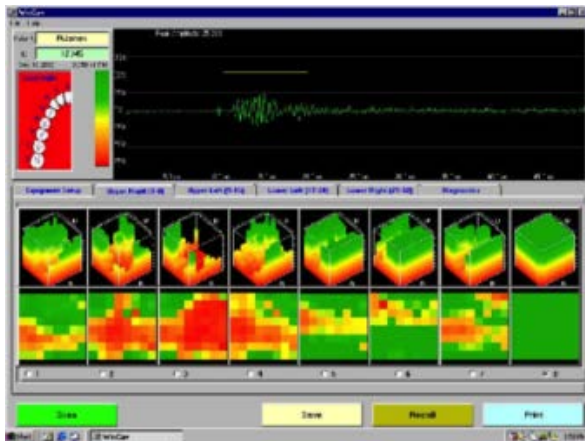
Cone Beam Tomography



Of course, our new age of cone beam CT imagery gives us a better view of the contents of the marrow spaces. We can find condensing osteitis and cavitated empty zones with much greater accuracy than ever before. This is a particularly clear example of a residual hollow in the jawbone, where a lower third molar had been extracted years before. The numbers are Hounsfield radiographic density measurements, which are produced by many cone-beam computed tomography systems (CBCT) software packages. Often the Hounsfield scores will resolve an area of reduced bone density better than the graphic appearance.

Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Cavitat



Until the company went out of business in 2005, there was a through-transmission ultrasound system available, called the Cavitat. The system was based on the fact that dead bone, with its disconnected trabecular structure, could not conduct sound the way intact bone does. A signal generated between a sending and a receiving contact, held on either side of the alveolar process, would be converted to a three-dimensional image of a volume of jawbone.

Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Damaged bone was rendered in red, while normal bone would be seen as green. Some very useful clinical and research work was done with this instrument, and its absence has negatively impacted further work in this area.

The McMahon – Ratner Method

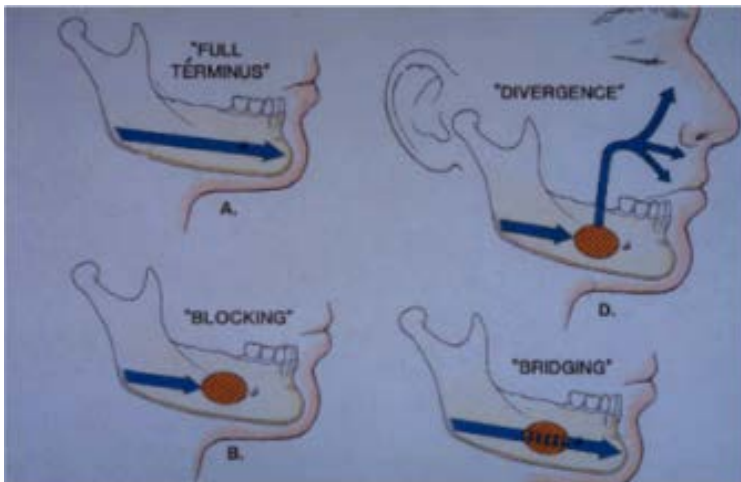


Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

The McMahon-Ratner method is for detecting lesions by administration of the inferior alveolar nerve block.

ISCHEMIC OSTEONECROSIS AND NEURALGIA

Besides the upper and lower jawbones, no other bone in the body is traversed by such large sensory nerves. So, it's not surprising that ischemia and necrosis in the jawbones can affect the nerves, and in some cases cause pain. In fact, about 85% of neuralgias are associated with the trigeminal nerve, and many appear to derive from sites of ischemic bone in the jaws.

The term we use for jawbone osteonecrosis associated with pain is NICO, or “neuralgia-inducing-cavitational-osteonecrosis.” As biological dentists we constantly look for strategies to treat, and possibly to prevent, NICO and other ischemic lesions.

Most of the scientific inquiry into jawbone osteonecrosis was done in regard to its relationship with pain: facial neuralgias, atypical facial pain, trigeminal neuralgia, migraine, and pain referred to distant sites. Several surgeons, starting with Dr. E. J. Ratner in 1976, have reported high rates of relief from neuralgic pain when ischemic jawbone sites are identified and treated. The first step, as Ratner recommended, is to confirm the connection between the site and the pain with local anesthetic. After that, the sides would be opened surgically and curetted of the necrotic contents. Reliable relief of neuralgias have been reported, although it sometimes would take repeated surgical treatments to reach the final result.

Source: Ratner EJ, Person P, Kleinman DJ, Shklar G, Socransky SS. Jawbone cavities and trigeminal and atypical facial neuralgias. *Oral Surgery, Oral Medicine, Oral Pathology*. 1979 Jul 1;48(1):3-20.

NICO TREATMENT METHODS

In this excerpt from the IAOMT’s Word of Mouth Podcast, Dr. Jerry Bouquot talks with Dr. Stuart Nunnally about some of the treatment methods for lesions in the mandible. After the video, we’ll discuss some of these methods, as well as others, in more detail.

Insert 31:56-37:47 from <https://wordofmouth.iaomt.org/s01-e05-jerry-bouquot-dds-msd-neuralgia-inducing-cavitational-osteonecrosis-nico/>

NICO: IT'S IMPORTANT TO FIND THE LESION
BECAUSE CURETTAGE OF CANCELLOUS LESION SEEMS TO WORK!

Authors	Country	Year	# Patients	Median Post-op Pain Reduction
Ratner et al.	USA	1976	26 *	100%
Ratner et al.	USA	1979	61 *	93
Roberts et al.	USA	1979	42 *	100
Shaber et al.	USA	1980	8	100
Mathis et al.	USA	1981	8	100
Wang et al.	China	1982	103	100
Demarath, Stal	USA	1982	29	50
Roberts et al.	USA	1984	208 *	95
Grechko, Puzin	Russia	1984	65	100
Ratner et al.	USA	1986	1300 *	85
McMahan et al.	USA	1992	48	80
Bouquot et al.	USA	1995	102	72 **

* Probably overlapping patients in various studies
** Average follow time: 4.8 years

So, as you have heard, surgical curettage is one treatment method used for NICO. The success of surgical curettage of painful lesions seems to follow the old adage that where there is more bleeding provoked, bone will follow. Repeated procedures were required to reach the final result in many cases. Surgical curettage remains the standard for definitive treatment.

Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Anticoagulation, or use of medicines that help prevent blood clots, is another treatment method used for NICO. This is because some rate of relief of pain in long bones and jawbone neuralgias has been achieved with anti-coagulation therapy, counteracting the effects of the patients' endogenous hypercoagulations tendencies. It can provide relief in up to 40% of NICO cases, especially surgical failures.

For more information, see these sources:

Glueck CJ, McMahon RE, Bouquot J, Stroop D, Tracy T, Wang P, Rabinovich B. Thrombophilia, hypofibrinolysis, and alveolar osteonecrosis of the jaws. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 1996 May 1;81(5):557-66.

Gruppo R, Glueck CJ, McMahon RE, Bouquot J, Rabinovich BA, Becker A, Tracy T, Wang P. The pathophysiology of alveolar osteonecrosis of the jaw: anticardiolipin antibodies, thrombophilia, and hypofibrinolysis. *Journal of Laboratory and Clinical Medicine*. 1996 May 1;127(5):481-8.



Another treatment method for NICO is ozone therapy. Oxygen/ozone gas is injected in a dose-controlled manner into identified lesions and can be a profound disinfectant. Many of the anaerobic waste products of microbial metabolism are themselves pro-thrombotic and tend to perpetuate the ischemic problem. Ozone can also provoke a number of healing mechanisms that result in the generation of new circulation.

Authors of 2013 research entitled “A Review of the Properties and Applications of Ozone in Endodontics: An Update” documented a series of studies on the topic and concluded: “Ozone improves wound healing, assists in treating root caries and can be used against endodontic microbiota.”

Source: Mohammadi Z, Shalavi S, Soltani MK, Asgary S. A review of the properties and applications of ozone in endodontics: an update. *Iranian Endodontic Journal*. 2013;8(2):40.

Low level lasers and near infrared LED devices are used to promote bone healing and regeneration of circulation over a period of months. In research titled “Application of Photodynamic Therapy in the Treatment of Osteonecrosis of the Jaw” and published in 2020, the authors reported: “Besides the conventional surgical treatment, photodynamic therapy can be a viable supportive tool of initial and advanced stages of osteonecrosis and may contribute to improvements of patient’s quality of life.”

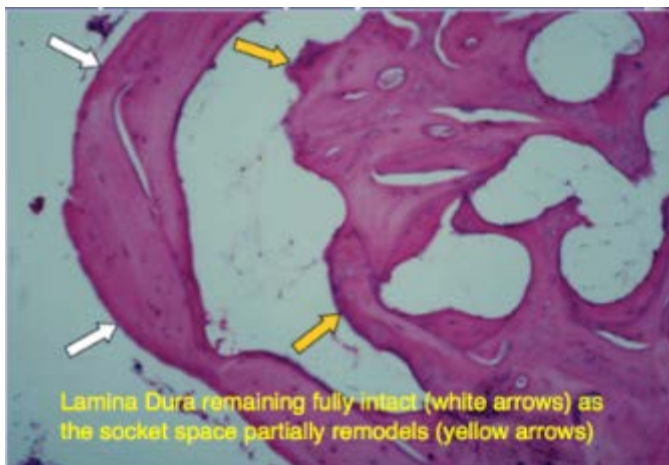
Source: Vuletić M, Brzak BL, Smojver I, Marković L, Sušić M, Gabrić D. Application of Photodynamic Therapy in the Treatment of Osteonecrosis of the Jaw. In *Photodynamic Therapy-from Basic Science to Clinical Research*. 2020 Oct 28. IntechOpen.

There are other NICO treatment methods being explored as well. For example, shockwave therapy is based on the principles of ultrasonic lithotripsy and success in treating orthopedic neuralgias. Inducing micro-trauma by treatment of ischemic jawbones with an extra-oral ultrasonic wand can induce new circulation and bone regrowth. As another example, platelet-rich fibrin is another NICO treatment method. The use of platelet-rich fibrin concentrates in surgical procedures is not only beneficial from a clotting standpoint, but also from the aspect of releasing growth factors over a period of up to fourteen days following surgery.

Is there such a thing as a simple extraction? It appears that some undetermined percentage of the population will experience ischemic bone healing of routine dental extractions due to their underlying hypercoagulation states, but dentists don't test for them before proceeding. Nor do we take into account the load of infection and trauma the site has accumulated. We just assume they'll heal.

Here are some strategies that biological dentists have come up with in an effort to mitigate these risks:

- Minimize the use of vasoconstrictors, even for surgery. This avoids the transient ischemia that can be so damaging to osteocyte viability.
- Curette the socket with a bur to remove remnants of the periodontal ligament. The ligament is a barrier that normally prevents the root surface from getting involved with the bone replacement cycle, so it may block the bone remodeling system from fully accessing the socket.



- Perforate or decorticate the lamina dura with a bur. This gives the marrow cells, macrophages and stem cells, better access to the organizing blood clot in the socket. It follows the concept that micro-injuries to bone stimulate better healing, too. See Lee TC, Staines A, Taylor D. Bone adaptation to load: microdamage as a stimulus for bone remodelling. *Journal of Anatomy*. 2002 Dec;201(6):437-46.

- Irrigate the extraction site copiously as you are curetting and burring. Use lots of saline, ozone-saturated water or saline, or other disinfecting solution. Try to reduce the local burden of infection.
- Employ good socket grafting to reduce dry sockets. Especially in favor now is the use of autogenous platelet-rich fibrin dressings.

HIDDEN PATHOGENS

If we can find evidence for ischemic bone lesions so often, and the majority of them are not painful, why should we be concerned?

The reason is they are toxic. They universally harbor anaerobic microbes: bacteria, fungi, and viruses. And these microbes may or may not be culturable, but they can be identified by their DNA. As well, the waste products that those microbes leave behind have also been shown to contain a number of toxic compounds.

Cytokine ratios are altered in ischemically damaged jawbone. Some investigators wonder if these jawbone lesions, affected as they are by microbes, microbial waste products, and altered physiology, are not a hidden source of systemic stress and immune disease.

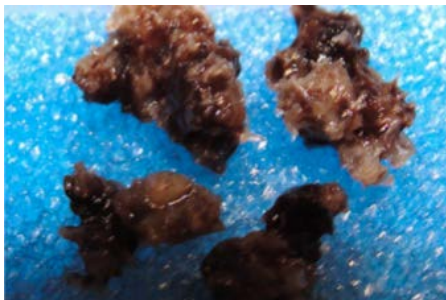
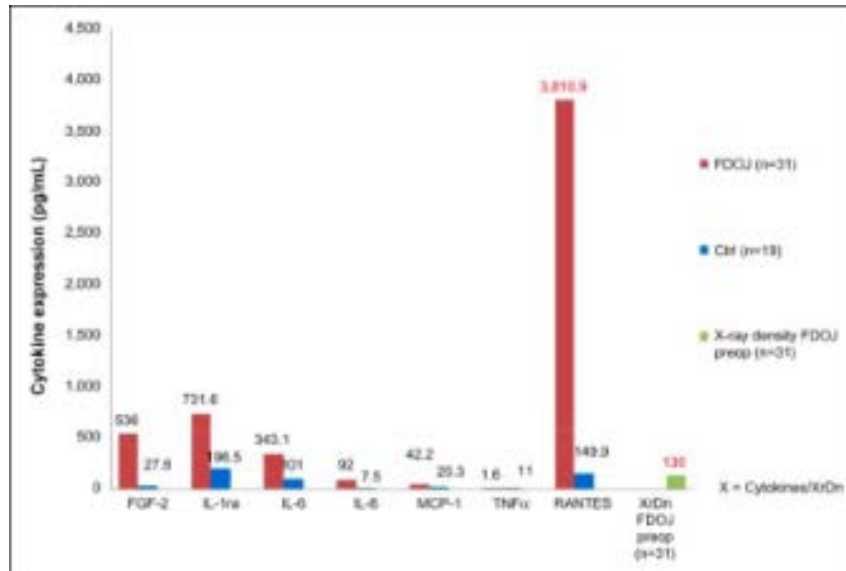


Photo courtesy of Dr. Jerry Bouquot, former website at www.maxillofacialcenter.com

Anaerobic microbes found in ischemic bone lesions leave behind waste products that have also been shown to contain a number of toxic compounds. These compounds have been shown to strongly inhibit a number of essential enzymes, and therefore are toxic to human physiology.

Toxins identified in osteo necrotic material:

- endotoxins
- fungal gliotoxins
- sulfides
- thioethers
- methyl mercaptan
- polyamines: putrescence and cadaverine



Source: Lechner J. Validation of dental X-ray by cytokine RANTES- comparison of X-ray findings with cytokine overexpression in jawbone. *Clin Cosmet Investig Dent*. 2014 Aug 21; 6:71-9.

Cytokine ratios are altered in ischemically damaged jawbone. We don't know why there is so little inflammatory infiltrate, or why pro-inflammatory cytokines are generally not elevated. But uniquely, chemokine CCL-5, otherwise known as RANTES, and Fibroblast Growth Factor FGF-2 have been found to be consistently very high in these bone samples.

- Elevated chemokine CCL-5, or RANTES
- Elevated fibroblast growth factor FGF-2
- Elevated IL-1ra, (anti-inflammatory receptor antagonist)

Overexpression of RANTES is found in many immune diseases, leading some investigators to wonder if these jawbone lesions are not a hidden source of systemic stress and disease in this way.

Source: Lechner J, von Baehr V. Chemokine RANTES/CCL5 as an unknown link between wound healing in the jawbone and systemic disease. *EPMA J*. 2015 May 6;6(1):10.

Root canal treatments, extractions, dry sockets, apical periodontitis-- in fact all the ways that dental diseases and dental treatments breach the barriers between the oral cavity and the internal, medullary spaces of the jawbones, have the potential to introduce germs into the bone marrow. These germs may never be fully eliminated by normal immune system function. Infection and trauma predispose bone marrow to ischemic osteonecrosis, which in turn provides "dead space." This creates zones of poor circulation where microbes can persist.

We make these statements based on somewhat limited research, some of which has not actually been published.

SUSPICIONS ABOUT ROOT CANAL TREATMENT

Most dentists have a deep and abiding faith in root canal treatment. Other dentists have long suspected that this confidence may not be fully justified. While most treatments end up leaving no pain, frequent patient complaints about persistent pain or discomfort do exist. Anecdotes abound about distant pains and systemic symptoms like fatigue, malaise, and even named diseases that clear up when root-treated teeth are extracted. Dentist themselves may have the experience of extracting asymptomatic, but un-restorable treated roots, and find that they often smell terrible.

Suspicion about the viability of root canal therapy goes back to the very beginning. The original studies that indicated negative systemic effects came from pioneering dental researcher Dr. Weston Price in the 1920s. Price documented experiments in which he extracted root treated teeth from patients with medical illnesses and implanted fragments or extracts of the roots under the skin of rabbits. The rabbits proceeded to develop diseases that were similar to the humans, and most of them died quickly. The implication was that toxins produced by anaerobic bacteria remaining in the treated roots were leaching out and undermining the patients' health.

Early indications of health recoveries created by extracting root treated teeth in the 1920s and the 1930s led to wide acceptance of a theory of focal infection. The theory stated that infection lodged in one part of the body, in particular the susceptible teeth would metastasize to other organs like joints, the heart, lungs or kidneys, and create disease there. Extracting the teeth would relieve the infection pressure and therefore the medical illness. Eventually, medical and dental science realized that this was not a consistent or reliable solution to illness in the population, and the whole edifice came apart after World War II and the introduction of effective antibiotic therapy.

Today the focal infection theory has been revived, largely in regard to the oral-systemic connection concerning periodontal disease. But little has been made of the possibility of an oral-systemic link based on persistent infection and inflammation from root canal treated teeth.

It's a long established fact that when a root canal is infected, the dentinal tubules become populated by some of the invading species. And they can persist for a long time, living by slow anaerobic metabolism. The theory in endodontic practice has been that such remnant populations don't matter because they are harmlessly trapped between the sealed canal in the impermeable layer of cementum on the outer surface of the root. Really, it's a simplistic and static view, considering the aggressive dynamics of microbial growth, and the effects of time breaking down the seal in treated canals and the structures of the root itself.

We all know what happens when you bury a living organism without actually killing it. Microbes and their metabolic waste products, trapped in the dental tubules of a root, will in, in the long run, have access to the marrow spaces. The endodontic seal can eventually breakdown, and the toxic waste molecules can even slowly diffuse through the cementum. Moreover, a tooth that starts with a periapical infection may have a microbial biofilm on the apical surface that cannot be affected by endodontic treatment. Some biological dentists actually reject the whole concept of root canal therapy. They say there is no justification for leaving dead organs embedded in the body.

BEYOND THE X-RAYS AND INTO THE ROOTS

The classic definition of endodontic success goes back five decades, as these two quotes from research in the 1970s demonstrate:

“[The case] in which the periapical bone structure in the periodontal membrane appeared normal on the roentgenogram and the tooth was entirely comfortable. A case was judged unsuccessful if an area of rarefaction had developed where none had existed before, if a previous area of refraction had not repaired, or if, on checkup, the tooth was sensitive to percussion or was uncomfortable.”

Source: Goldman M, Pearson AH, Darzenta N. Reliability of radiographic interpretations. *Oral Surgery, Oral Medicine, Oral Pathology*. 1974 Aug 1;38(2):287-93.

“It is clear that the radiograph is a very questionable means of determining success and failure. This is not surprising, for we reinterpret radiographs - we do not read them.”

Source: Goldman M, Pearson AH, Darzenta N. Endodontic success—who's reading the radiograph? *Oral Surgery, Oral Medicine, Oral Pathology*. 1972 Mar 1;33(3):432-7.

There is a vast amount of literature on the meaning of radiographic interpretation of endodontic treatments. The reliability of radiographs to prove success is always in doubt.

For example, in an autopsy study that examined block sections of 29 root treated teeth, ten had radiographic rarefactions and histologically verified periapical. Of the nineteen that were radiographically normal, five had periapical inflammation when examined histologically.

Source: Green TL, Walton RE, Taylor JK, Merrell P. Radiographic and histologic periapical findings of root canal treated teeth in cadaver. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 1997 Jun 1;83(6):707-11.

Cone-beam computed tomography systems (CBCT) offer a new level of seeing beyond just the x-ray and getting to the root of dental conditions. For example, in 2014, researchers explained: “...CBCT imaging appears to provide a superior validity and reliability in the detection of periapical lesions.”

Source: Venskutonis T, Plotino G, Juodzbaly G, Mickevičienė L. The importance of cone-beam computed tomography in the management of endodontic problems: a review of the literature. *Journal of Endodontics*. 2014 Dec 1;40(12):1895-901.

As another example, we will share the following photos provided by Steve Koral, DMD, MIAOMT, from a case of an endodontic treatment that would have been acceptable until the CBCT reveals the extent of its failure.



This x-ray shows an upper left second molar at a PA (preparatory appointment) at the time of treatment.



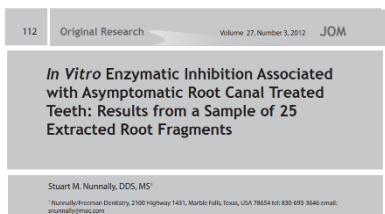
This x-ray from a follow up PA, eighteen months later, shows a reasonable degree of healing.



However, this CBCT scan taken the same day, rotated into the coronal plane, shows how the healing was illusory. Yet the tooth was entirely comfortable. Is it a treatment failure?

And what exactly is in those roots? Beyond massive numbers of anecdotes and the percentage of teeth that smell bad when extracted, evidence for the toxicity of root canal treatments is sparsely documented. The best recorded phenomenon is the ability of dilute extracts from the surface of extracted, treated roots to inhibit critical enzymes.

This has been explained in an article titled “In Vitro Enzymatic Inhibition Associated with Asymptomatic Root Canal Treated Teeth: Results from a Sample of 25 Extracted Root Fragments” by IAOMT’s Dr. Stuart Nunnally. In this research, Dr. Nunnally tested six enzymes that are critically important for human life to determine their percent inhibition when exposed to root fragments of 25 extracted root canal treated teeth. The results were that the enzymes averaged 65.6% inhibition, which reflected severe toxicity. However, these reports suffer from a lack of data from untreated controls.



Source: Nunnally SM. In Vitro Enzymatic Inhibition Associated with Asymptomatic Root Canal Treated Teeth: Results from a Sample of 25 Extracted Root Fragments. *Journal of Orthomolecular Medicine*. 2012 Sep 1;27(3).

Recent scientific literature has shown that having one or more root canal procedures is associated with an increased incidence of coronary heart disease. A 2013 study examined the blood clots that caused heart attacks (myocardial infarction) and found a high concentration of the DNA found in the pathogens mostly commonly seen in root canal-treated teeth, as well as in chronic gum disease. The same types of oral pathogen DNA have also been identified in a majority of ruptured intracranial aneurysm specimens obtained from patients, as well as in a majority of the samples of pericardial fluid surrounding the hearts of chronic coronary artery disease patients.

Sources:

Frisk F, Hakeberg M, Ahlqwist M, Bengtsson C. Endodontic variables and coronary heart disease. *Acta Odontologica Scandinavica*. 2003 Jan 1;61(5):257-62.

Joshiyura KJ, Pitiphat W, Hung HC, Willett WC, Colditz GA, Douglass CW. Pulpal inflammation and incidence of coronary heart disease. *Journal of Endodontics*. 2006 Feb 1;32(2):99-103.

Pessi T, Karhunen V, Karjalainen PP, Ylitalo A, Airaksinen JK, Niemi M, Pietila M, Lounatmaa K, Haapaniemi T, Lehtimäki T, Laaksonen R. Bacterial signatures in thrombus aspirates of patients with myocardial infarction. *Circulation*. 2013 Mar 19;127(11):1219-28.

Pyysalo MJ, Pyysalo LM, Pessi T, Karhunen PJ, Öhman JE. The connection between ruptured cerebral aneurysms and odontogenic bacteria. *Journal of Neurology, Neurosurgery & Psychiatry*. 2013 Nov 1;84(11):1214-8.

Louhelainen AM, Aho J, Tuomisto S, Aittoniemi J, Vuento R, Karhunen PJ, Pessi T. Oral bacterial DNA findings in pericardial fluid. *Journal of Oral Microbiology*. 2014 Jan 1;6(1):25835.

DIFFERENT OPINIONS ON ROOT CANAL TREATMENT

So, what does this apply to our practice of dentistry in the human population, where people expect to have their teeth fixed and maintained? And where our sworn mission is to treat and keep teeth? Are we compromising everyone's, or anyone's, health with our current methods of treating dental disease? Is there a segment of the population that is especially susceptible to the toxic exposure that we know can be present?

Anybody can recognize overt treatment failures. But the problem is especially vexing when we are faced with asymptomatic root canals and painless, and apparently healed, extraction sites. If it is not an overt failure, we have no way to test if these treatments are a significant stress on the patient's health. As well, we have no tests to measure if they are healed to within the patient's threshold of tolerance.

Some dentists take the position that no root canal treatments can possibly be healthy, and that any detectable ischemic site is a toxic cavitation. Their clientele tends to consist of patients with medically-unresolved, systemic-health problems who are looking outside of traditional medicine for help.

Dr. Hal Huggins and his followers have developed a treatment concept referred to as: the complete dental revision.

Text on screen:

Complete Dental Revision:

- Nutritional counseling
- Biocompatibility testing
- Amalgam removal
- Removal of disparate metals
- Extraction of all root canals and infected teeth
- Decortication of extraction sockets
- Surgical curettage of osteonecrotic zones
- Restorations with biocompatible materials

They employ all of the concepts of biological dentistry that we have discussed, and more, to get rid of all identifiable sources of toxicity and stress in the mouth. A criticism of this approach has been that such comprehensive removal of teeth, and curettage a bone, can leave a patient with such little jaw structure that few dental reconstruction options remain.

No one has published a comprehensive review of the outcomes of these complete revision cases. There are a great many patients who credit their health recoveries to their dental revisions. There are also those who did not get relief from their health problems with dental revisions.

Meanwhile, new research continues to confirm the long-debated connection between the health of the mouth and the rest of the body, and this is highly pertinent to root canals. For example, a study published in February 2019 linked root canal infections with increased inflammation and a moderate to high cardiovascular risk.

Source: Garrido M, Cárdenas AM, Astorga J, Quinlan F, Valdés M, Chaparro A, Carvajal P, Pussinen P, Huamán-Chipana P, Jalil JE, Hernández M. Elevated systemic inflammatory burden and cardiovascular risk in young adults with endodontic apical lesions. *Journal of Endodontics*. 2019 Feb 1;45(2):111-5.

A second study in the same peer-reviewed *Journal of Endodontics* also reported associations between infections around the end of the root of the tooth and cardiovascular diseases.

Source: Messing M, de Souza LC, Cavalla F, Kookal KK, Rizzo G, Walji M, Silva R, Letra A. Investigating potential correlations between endodontic pathology and cardiovascular

diseases using epidemiological and genetic approaches. *Journal of Endodontics*. 2019 Feb 1;45(2):104-10.

These papers add to the growing body of research over the past two decades that supports concerns about chronic inflammation and residual infections around and inside the non-vital teeth being associated with increased risks of health problems.

Especially in light of all this compelling research, it should also be remembered that the goal of endodontic therapy, or root canal therapy, is to prevent and/or treat infections of these structures.



Endodontist and IAOMT member Valerie Kanter, DMD, MS, BCN, has explained: “We need more research that would more clearly delineate which root canals are a burden to the body and which ones are coexisting without negative impact. Many factors have been associated with the effectiveness of endodontic treatment, such as the use of dental dams, surgical operating microscopes, periodontal condition, and the quality of the final restoration.”

Dr. Kanter actively researches newer technologies that are being used to improve the standard of care for root canal treatments. She believes that a new paradigm in endodontics is overdue. In Dr. Kanter’s opinion, the use of a microscope, CBCT, advanced irrigation and disinfection techniques and pre-op and post-op biological monitoring (hs-CRP, various cytokines, fibrinogen, etc.) should be the new standard of care. Dr. Kanter also believes that patients should seek care from qualified specialists that use advanced 3D debridement and disinfection protocols.

Clearly, within the IAOMT, there are varying opinions on root canal treatment. Some of our members do not perform them at all, some of our members occasionally perform them, and some of our members routinely perform them.





Meanwhile, the following statement written in a status report by IAOMT in 2001 still rings true: The IAOMT cannot take the position that all non-vital teeth must be extracted. On the other hand, it is clear that non-vital teeth -- with or without endodontic therapy -- can present a systemic health risk to some patients.

Each patient must be evaluated on an individual basis, considering the medical status and other factors. The IAOMT encourages the dental, medical, and scientific communities to address this area with vigor. Efforts must be made to provide valid methods of determining the systemic health risk from non-vital teeth and provide techniques of endodontic therapy that eliminate, or at least reduce, the risk.

CONCLUSION

It is our duty to inform patients as to the benefits and risks of root canal therapy. Similarly, we must thoroughly discuss the positive and negative consequences associated with extractions. To educate our patients is to act with integrity.

In this course we have emphasized the bad news: the previously unsuspected prevalence of jawbone osteonecrosis, the toxic nature of ischemic and necrotic zones, and the toxic nature of root canal treatments. And we touched on the systemic implications. There is good news, too. There are treatment strategies that we can use to mitigate some of these hazardous effects. You can find more information on our website, iaomt.org.

POSTFACE TO IAOMT'S HIDDEN PATHOGENS IN ROOT AND JAWBONE ONLINE LEARNING VIDEO ACTIVITY

Text on screen:

You have finished viewing the video component of this activity. If you are participating in this activity as part of an IAOMT course, you must successfully complete a quiz to obtain credit. Access to the quiz is provided in the "Activity Content" below this video, as well as on the menu to the left. Additionally, the "Materials" tab above this video contains links to references and resources cited in this activity, scientific literature related to the topics presented, and a script for this entire video. Thank you for learning with the IAOMT, as we work together to achieve safer dentistry and a healthier world.